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Feeder Protection from Over Load and Earth Fault Relay

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***Abstract*: A bus bar in electrical power distribution refers to thick strips of copper or aluminium that conduct electricity with in a switchboard, distribution board, substation or other electrical apparatus. In this project bus bar can be protected from the over current condition. Industrial instruments failures have many causes and one of the main causes is over load. The primary of the distribution transformer or any other transformer is designed to operate at certain specific current if that current flowing through that instrument is more than the rated current, then immediately the system may burn because of over load, through this project we are going to protect the bus bar from over load condition. In this project work for generating high current more loads are applied to the circuit will be tripped. To trip the circuit, we are using one relay which will control through our comparator. When over load is occurred relay will trip the total circuit and buzzer will on to indicate over load. For protection of bus bar from over current condition first we have to measure the total load current which is flowing through the bus bar. Under healthy condition the resultant current flowing through the secondary grounded neutral current transformer will be zero. In such a three-phase system if one of the three phases get grounded or earthed then unbalancing of current occurs, the vector sum of all three phases will have certain value. If this value exceeds the set value indicated on the relay, then the relay actuates and trips the main circuit. The primary of the distribution transformer or any other transformer is designed to operate at certain specific current if that current flowing through that instrument is more than the rated current, then immediately the system may burn because of over load, through this project we are going to protect the bus bar from over load condition.**

***Keywords*: Arduino UNO, Current Sensor, Earth Fault Relay, Load.**

1. Introduction

In electric power distribution, an automatic overload protection system is a circuit breaker equipped mechanism that can be automatically closed after an event occurred on the line. Automatic overload protection system is used in coordinated protection schemes for overhead line power distribution circuits. This project consists of a digitalized voltmeter and a phase sequence relay, earth-leakage circuit breaker, three phase overload relay and a contactor used for over-current, overload and earth fault protection. In this project, the main aim is to protect bus bar from the over current condition. The primary of the distribution transformer or any other transformer is designed to operate at certain specific current if that current flowing through that instrument is more than the rated current, then immediately the system burns because of overload. Through this Project we are going to protect bus bar from such over load condition.

2. Literature survey

A. An efficient monitoring of substations using microcontroller based monitoring system

Authors: V. Thiyagarajan & T.G. Palanivel

The paper proposes an innovative design to develop a system based on AVR micro controller that is used for monitoring the voltage, current and temperature of a distribution transformer in a substation and to protect the system from the rise in mentioned parameters. Providing the protection to the distribution transformer can be accomplished by shutting down the entire unit with the aid of the Radio frequency Communication. Moreover, the system displays the same on a PC at the main station which is at a remote place. Furthermore, it is capable of recognizing the break downs caused due to overload, high temperature and over voltage. The design generally consists of two units, one in the substation unit, called as transmitter and display unit, and another in the Main station called as controlling unit. The transmitter and the display units in the substation is where the voltage, current and temperature are monitored continuously by AVR microcontroller and is displayed through the display unit.

B. Substation monitoring and control using microcontroller & GSM

Authors: Mrs. Krupal Dhimar, Mr. Jenish Patel, Mr. Yasin Shaikh, Mr. Anas Musani, Mr. Krishn Patel

The purpose of this project is to acquire the remote electrical parameters like voltage, current and frequency and send these real time values over gsm network using gsm modem/phone along with temperature at power station. This project is also designed to protect the electrical circuitry by operating a spdt relay. This relay gets activated whenever the electrical parameters exceed the predefined values. The relay can be used to switch off the main electrical supply. User can send commands in the form of sms messages to read the remote electrical parameters. This system also can automatically send the real time electrical parameters periodically (based on time settings) in the form of sms. This system can be designed to

send sms alerts whenever the relay trips or whenever the voltage or current exceeds the predefined limits. This project makes use of a microcontroller. The controller can efficiently communicate with the different sensors being used.

3. Feeder Protection from Overload.

In this project we are using the Arduino UNO as a microcontroller device which is main component or heart of this project. We are designed a simple prototype module for protection of feeders from overload by using the Arduino UNO Microcontroller, Current Sensor, 16 Bit ADC 0808, LCD Display (16*2), Relay Module, IOT Module, GPS Module, Buzzer Kit, Lamp Load & Power Supply to the Feeders. The feeder can be pass over current either by overloading condition or either by short circuit of more than one feeder to each other. In the automatic feeder protection system for a fault detection purpose the current sensing unit was provided in the circuit. This current sensing unit is detecting the fault in the power lines and pass the fault signal to the line controller unit. In that project we are generates the amount of high current by increasing the lamp load. The lamps are resistive in nature so the amount of heat can be generated and hence load current was increased as per increasing load. Hence this increased load current start flowing through the power lines. The current sensor is sensing the current which is connected in series with power lines and pass the output signal of CT to the overload circuit unit. When the overload signal is comes to the overload unit, it gives instruction to the relay to trip it and isolate the circuit immediately. The relay circuit was controlled by using the Arduino UNO microcontroller.

4. Existing system

In Existing system, the load current is increasing in nature so it will directly affect to the consumers equipment and utility side consumers. The equipment connected in consumer side will be collapse due to over current flows in the circuit. There is no specific controller is installed in a power lines for fault detection purpose. The existing system was not be able to detect the faults like feeder overloading, short circuit of feeders and earth faults because of chances of collapsing the equipment due to large over load current.

5. Proposed system

To overcome the situations like overloading of feeders or short circuit in feeders which will discussed in last paragraph, we have designed a simple prototype model of Feeder Protection from Overload and Earth Fault Relay to prove the concept in details. In this project we are using the current sensors in series with feeders to detect the fault like overload condition or short circuit condition. After sensing the fault, the microcontroller has sent signal to overload unit to trip the relay immediately. Also sends SMS through IOT modules by tracing the location by using GPS module when overload or earth fault detected.

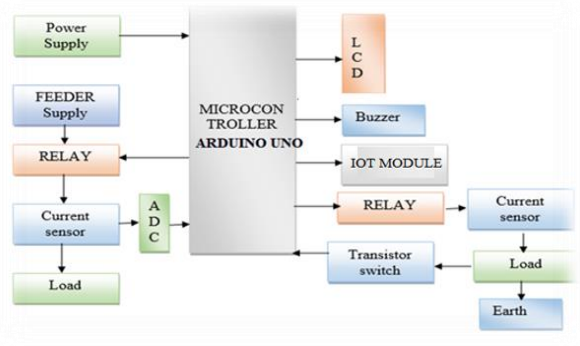

Fig. 1. Block diagram

6. Hardware requirement

- Arduino UNO
- Current sensor
- Relay module
- LCD display
- IOT module
- Buzzer
- Power supply

A. Arduino UNO

Fig. 2. Arduino UNO.

The Arduino Uno is a microcontroller board or device which follows the instructions based on the ATmega328 (datasheet). It has 14 digital I/O pins. Out of that 14 Pins the 6 pins are used for

- Buzzer
- Power supply

7. Software requirement

- Arduino ide (programming)
- Proteus(simulation)

The PWM (Pulse Width Modulation) outputs and another 6 pins used as analog outputs. The resonator clock speed of Arduino UNO is 16MHz. It has provided USB connection, a power jack, ICSP header and reset button. Its designed specially to support on microcontroller and easy to interface with PC by using the USB cable/AC-to-DC Adaptor/ Battery for starting purpose. The design of UNO circuit is different than other boards because its unusual for FTDI USB to serial driver chip. Due to its futures Atmega16U2 up to version R2 is programmed

for USB to serial communication. Specifications:

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output and 6 Analog Input Pins)
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328) of which 0.5 KB used by boot loader S
- RAM: 2KB (ATmega328)
- EEPROM: 1KB (ATmega328)
- Clock Speed: 16 MHz

A. Current sensor

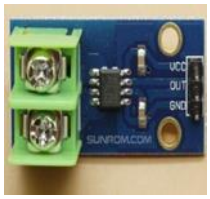

Fig. 3. Current Sensor

The current sensors used for sense the current. ACS712 current sensor which operates on 5V and the measured current of the feeders are proportional to the analog output voltage. The current sensor having following features:

- 100 mV/A output sensitivity
- 5.0 V, single supply operation
- Output voltage proportional to AC or DC currents
- Factory-trimmed for accuracy
- Extremely stable output offset voltage
- Nearly zero magnetic hysteresis
- Radiometric output from supply voltage
- Low-noise analog signal path
- Device bandwidth is set via the new FILTER pin
- 5 µs output rise time in response to step input current
- 80 kHz bandwidth
- Total output error 1.5% at TA = 25°C
- Small footprint, low-profile SOIC8 package
- 1.2 mΩ internal conductor resistance
- 2.1 kVRMS minimum isolation voltage from pins 1-4 to pins 5-8

B. Relay module

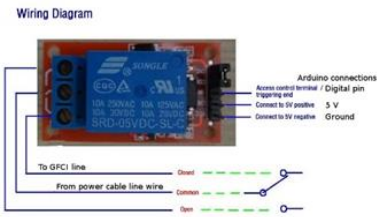

Fig. 4. Relay Interfacing with Arduino

The relay is the protective device which used to isolate the system under faulty condition. When a fault occurs in the feeder it passes the signal to the overload unit through CT. The overload circuit contacts with circuit breaker and circuit breaker gives instruction to the relay circuit to trip it and isolate the faulty circuit immediately. The relay has different types according to their construction and working principle. It may be electrically operated relay or mechanically operated relay. The relay is nothing but a protective switch which operated only faulty condition. Under healthy condition its closed condition in the system. In this project first relay acting like as an Amplifier. It repeats the signal from one circuit and retransmit the signal to any other circuit. The relay is used for telephone exchanges for radio modems and computers to perform the logical operations during programming.

C. LCD Display

Fig. 5. LCD Display

An LCD screen constructs as two horizontal lines and each line has 16 character displaying capacity. Each character has 5x7 dot matrix. The contrast on display depends on provided power and messages size and words. The pin configuration is provided for that purpose. If variable voltage is 0-Vdd the it shows on pin Vee with the help of trimmer potentiometer. Some displays used a different colour for their indications. During backlight condition blue or green diodes used or during operating conditions any LE diodes are used to show the results on display.

D. E. E. GPS Syste:

The GPS stands for Global Positioning System it's a spaced based navigation system which includes standard time information with respect to all whether conditions and provides a various remote location data by the use of satellite in 1975 the American defence was created this system. Now a days this system was freely accessible to everyone. In this project the use of GPS plays an important role is to send and receive data from various remote locations and provide a solution under faulty condition.

E. Buzzer

Fig. 6. Buzzer Circuit.

A buzzer is the device which produces the beeping noise

called as Buzzing. There are several types of buzzers available in market but most basic usually buzzer is piezoelectric buzzer. It having two electrodes and a flat piece is mounted between them. They are cheap and able to produce high sound during faulty condition without using extra high power. The piezoelectric material can produce a voltage with respect to pressure. In our project the buzzer is used to indicate the fault by Alarm Annunciation.

F. Power Supply

In this project we are used the 5V, 500 mA rating Regulated Power Supply. For voltage regulation purpose we are using 7805 three terminal voltage regulators. To rectify the output of 230/12V step down transformer the AC Full Wave Bridge Rectifier is used.

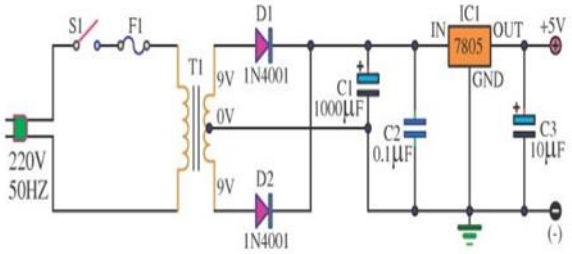

Fig. 7. Block Diagram of Power Supply

G. Advantages

- Efficient and min cost design.
- Low power consumption circuit.
- Real time data monitoring.

8. Applications

- This project is used for protecting Bus bars in sub stations, generating stations etc.
- Used for Industrial appliances protection.
- This system can be implemented in industries.
- This system can be used to monitoring and controlling the home appliances.

9. Future scope

It is almost impossible to have a protection scheme suitable for all situations. It is, therefore, important to consider some of the situations for which the further study is required. Suggested below are the few areas which can be further explored to improve the protection schemes in the presence of DG?

- The Current Transformers (CTs) has not been modelled in all the computer simulations used in the present work for its saturation detection. Consequently, the design parameters such as the characteristic of CT, knee point of CT, properties of material used for core and dimension of CT affect the performance of CT. Hence inclusion of this parameter provides gravy areas to be looked into for further research.
- After modelling the complete radial distribution system in the presence of DG in PSCAD software, a new directional relaying protection scheme was tested in low voltage laboratory environment. However, definitely, its validation can be done by real time implementation in the field.

10. Conclusion

In this project we know the knowledge about attain control and monitoring of feeder protection from overload conditions by measuring the temperature. We have designed a GPS technology-based prototype module for collecting real time data from various remote locations and send to user mobile through IOT Technology.

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